

Understanding 3D Animation Using Maya

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For Erin and Ronan

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Preface

Overview

If learning Maya seems like an overwhelming task, and you don't know where to begin, then this book is for you. You'll learn the fundamentals from the ground up, in an order that'll make sense. After reading *Understanding 3D Animation Using Maya*, you'll be able to create original 3D animation from scratch.

This is a self-training manual for beginning Maya users. It's both a general guide for understanding 3D computer graphics and a specific guide to learning Maya. By learning the fundamentals, you'll be able to tackle more complex tasks later on – your subsequent work in Maya will fit into a familiar framework.

With this book, you'll gain extensive knowledge in the key areas of 3D animation:

- Workspace – Getting the most out of the interface and workflow;
- Modeling – Creating objects and characters using real-world techniques;
- Animation – Adding motion to your objects and bringing your characters to life;
- Shading – Developing the look of your surfaces;
- Lighting – Illuminating your scenes with artfully placed lights;
- Rendering – Filming your scenes with virtual cameras.

Organization and Features

Have you noticed the sheer number of menu items and buttons available in Maya? If so, you probably realize that this is one huge piece of software – Maya can do a wide range of things with a tremendous amount of depth. To make this power usable and to make Maya's features accessible to you, I cover all six fundamental topics in each chapter – this works better than isolating subjects such as modeling or rendering. Each chapter advances the concepts and skills a bit further than the last, while always emphasizing the big picture. From my experience teaching Maya, I've found it's beneficial to learn the basics and how they relate to each other, rather than to focus, at the outset, on a single topic in too much detail.

After reading about each topic, you'll be presented with one or more hands-on tutorials. By completing the tutorials, you'll get a good feel for a typical 3D animation workflow, and you'll be well on your way to creating your own 3D animation project.

Here's a breakdown of what you'll find in each chapter

Chapter 1 – Essential Skills

You'll get your feet wet in this chapter: make your way around the interface; model some simple characters using primitive building blocks; animate a ball using keyframes; play around with the color and shininess of materials; place point lights with shadows; and render images of your finished scenes.

Chapter 2 – Refinements

Take a closer look at important details such as project management and file organization, and explore the different geometry types (NURBS, polygons, and subdivision surfaces). Copy keyframes and place pivot points for control over your animation; learn how to choose different material types to create plastic, metal, and other shaders; place spotlights and manipulate their parameters; and add sophistication to your camera work.

Chapter 3 – Intermediate Skills

Find out how to use the Hypergraph to explore Maya's node-based architecture; create models using curve-based techniques; fine-tune your animation with the Graph Editor; add detail to your materials with texture maps; develop sophisticated lighting with soft shadows and gobos; and render realistically using depth of field.

Chapter 4 – Adding Character

Learn how marking menus, shelves, and other interface elements can be used to speed up your workflow; model your own characters using polygon and subdivision sculpting techniques; build complex animated assemblies with hierarchies and groups; add bump maps and transparency to your materials; increase the realism of your lighting with area lights and raytracing; and render effects such as glows and lens flares.

Chapter 5 – Wiring Things Up

All elements in Maya can influence each other: use the Artisan painting interface for surface operations; connect multiple surfaces seamlessly with fillets; fly objects through your scenes with path animation; build skeletons to animate your characters; use displacement techniques to add surface details; apply custom UV mapping for accurate texture placement; illuminate your scenes with three-point lighting; and tell visual stories with camera cuts.

Chapter 6 – Bringing It All Together

In the final chapter it's time to combine your scenes into the final animated short: make the interface work for you with layers, hiding and showing, and snapping; add deformation techniques to your modeling toolkit; rig props and characters using animation constraints, inverse kinematics, and skin weighting; paint textures directly onto your models in 3D; use mental ray's Final Gathering for realistic, photon-based lighting; add motion blur for an added touch of realism; and import multiple elements into your final scene.

CD-ROM

The CD included with this book contains project directories with all the files you'll need to complete the tutorials and a finished version of each scene. In case you don't already own Maya, the CD has a full copy of the latest Maya Personal Learning Edition ready for you to install on Windows 2000, Windows XP, or Mac OSX. This free version of Maya enables you to start learning today.

Audience

This book is for anyone who is new to 3D animation in general or migrating to Maya from another 3D software package. It's aimed at everyone interested in being creative in 3D, including designers, animators, game artists, sculptors, photographers, illustrators, Web designers, fine artists, engineers, and visual communications students. The possibilities with Maya are nearly limitless; it's used for a wide range of tasks:

- Feature film and video animation and visual effects;
- Game asset creation and level design;
- Interface design;
- Graphic design;

- Medical, scientific, and military visualization;
- Architectural presentation;
- Design visualization;
- Theatrical lighting and set design.

This book provides you with everything you'll need to learn the most essential Maya skills. By applying an artistic eye, a passion for problem solving, and a willingness to practice, you'll find that the concepts of 3D animation aren't very difficult. Once you've applied these concepts to your own work a few times, they'll be yours forever.

Technical Notes

The techniques presented in this book will work in nearly any version of Maya. For compatibility reasons, the scenes have been saved in the Maya 4.5 .ma format. There should be no problems opening the scenes with versions 4.5, 5.0, or 6.0 under Irix, Red Hat Linux, Macintosh OSX, or Windows 2000/XP. For online book updates, go to www.understandingmaya.com.

The Maya Image Gallery contains images from the book that can only be fully appreciated in full color, as well as select images from a few animated short films.

In order to get the most out of the tutorials, there are some Maya preferences that you should set before getting started. Once you have launched Maya, click on the main menu **Window > Settings/Preferences > Preferences...** In this window, click **Edit > Restore Default Settings**, then change the following settings:

Interface category:	Open Attribute Editor = In Separate Window Open Tool Settings = In Separate Window
Kinematics category:	Joint Size = 0.5
Keys category:	Default In Tangent = Linear Default Out Tangent = Linear
Timeline category:	Playback Speed = Real-time [24 fps]
Undo category:	Queue Size = 100

Contents

Preface	ix
Maya Image Gallery	facing page 126
1. Essential Skills.....	1
1.1 Introduction to 3D Space – Cartesian Coordinate System	3
1.2 Workspace – Getting Around Maya.....	7
Input	9
Transformation Tools	10
Move Tool	11
Rotate Tool	11
Scale Tool	12
Show Manipulator Tool.....	13
Workspace Exercise – Transformation Tools	13
1.3 Modeling — Primitives, Wireframes, Surfaces, and Normals	17
Modeling Exercise – Chick	19
Modeling Exercise – Barn	26
1.4 Animation – Keyframe Basics	32
Animation Exercise – Ball Drop.....	33
1.5 Shading — Color, Specular, and Ambient	36
Shading Exercise – Shading Donuts	37
1.6 Lighting — Point Lights: Intensity, Color, and Shadows	40
Lighting Exercise – Lighting Donuts	41
1.7 Rendering — Outputting a Scene to Frames	45
Rendering Exercise – Rendering Donuts	46
1.8 Project 1 — Ball Rolling Down an Inclined Plane	51

2. Refinements	53
2.1 Workspace – Organization	54
The Outliner	55
Keyboard Shortcuts for Transformations	56
Project and File Management	57
2.2 Modeling – Geometry Types	59
NURBS	59
Polygons	59
Subdivision Surfaces	60
Component Mode	62
Modeling Exercise – NURBS Components	63
2.3 Animation – Copying Keyframes and Moving Pivots	68
Copying Keyframes	68
Animation Exercise – Copying Keyframes	68
Pivot Points	71
Animation Exercise – Pivot Points	73
2.4 Shading – Material Types	76
Shading Exercise – Material Types	77
2.5 Lighting – Spotlights	79
Lighting Exercise – Spotlight	80
2.6 Rendering – Camera Basics	83
Rendering Exercise – Two-node Camera	84
2.7 Project 2 – Rolling Egg	87
3. Intermediate Skills	89
3.1 Review – Attribute Editor	90
3.2 Workspace – Hypergraph	90
3.3 Modeling – Curves and Surfaces	92
Drawing Curves	92
Revolves	93
Construction History	94
Modeling Exercise – Revolves and Curve History	96

Modeling Exercise – Revolve and Extrude	97
Lofting	100
Modeling Exercise – Lofting Curves: Slide	101
Modeling Exercise – Lofting Curves: Fish	103
3.4 Animation – Fine Tuning Animation	106
Animation Exercise – Tangents	109
Animation Exercise – Tangent Plane	114
3.5 Shading – Texture Maps	120
Shading Exercise – Barn Textures	120
3.6 Lighting – Soft Shadows and Gobos	130
Soft Shadows	130
Lighting Exercise – Soft Shadow	130
Gobos	132
Lighting Exercise – Barn Gobo	133
3.7 Rendering – Depth of Field	136
Rendering Exercise – Depth of Field	136
3.8 Project 3 – Curved Half Pipe	139
4. Adding Character	141
4.1 Review – Graph Editor	142
4.2 Workspace – Efficient Workflow	142
Marking Menus	143
Hotbox	143
Interface Elements	143
Shelves	144
4.3 Modeling – Box Modeling with Polygons and Sub-d Surfaces	144
Modeling Exercise – Box Modeling Saddle	146
Modeling Exercise – Smooth Polygon Chicken	154
4.4 Animation – Hierarchies and Groups	162
Animation Exercise – Little Red Wagon	163
Transform Order	167
Animation Exercise – ‘Toon Tire	167

4.5 Shading – Bump Maps and Transparency	171
Bump Maps	171
Transparency	172
Shading Exercise – Butterfly	172
4.6 Lighting – Area Lights and Raytracing	176
Lighting Exercise – Cornell Box Area Lights	177
Raytracing	180
Lighting Exercise – Shiny Egg Raytrace	180
4.7 Rendering – Camera Effects	183
Light Glows and Lens Flares	183
Rendering Exercise – Optical FX Egg	184
4.8 Project 4 — Chicken Added to Scene	187
5. Wiring Things Up	189
5.1 Workspace – Artisan Tools	190
Workspace Exercise – Artisan	191
5.2 Modeling – Connecting Surfaces Using Fillets	193
Modeling Exercise – Submarine Fillets	194
5.3 Animation – Motion Paths, Driven Keys, Added Attributes, Skeletons	196
Motion Paths	196
Animation Exercise – Pursuit Plane Path	197
Driven Keys	202
Animation Exercise – Driven Keys	203
Added Attributes	205
Animation Exercise – Added Attributes	206
Skeletons	209
Animation Setup Exercise – Chicken Skeleton	211
Posing the Skeleton	220
Animation Exercise – Keyframing the Skeleton with MEL	221
5.4 Shading – Displacement and UV Texture Mapping	227
Displacement	227
Shading Exercise – Displacement Wing	227

UV Texture Mapping	232
Shading Exercise – UV Chicken	233
5.5 Lighting – Three-point Scheme	251
Lighting Exercise – Three-point Lighting Plane	252
5.6 Rendering – Camera Cuts	256
Rendering Exercise – Camera Cuts	256
5.7 Project 5 – Preparing for Animation	260
6. Bringing It All Together	261
6.1 Review – Editing Your Camera Cuts	262
6.2 Workspace – Layers, Show by Type, Hiding and Showing	262
Layers	262
Show by Type	262
Hiding and Showing	263
Snapping	263
6.3 Modeling – Cluster Deformers	264
Cluster Deformers	264
Modeling Exercise – Clusters	265
Modeling Exercise – Chicken Head Clusters	269
6.4 Animation – Constraints, Inverse Kinematics, and Skinning	271
Constraints	271
Animation Exercise – Point Constraint Egg	274
Animation Exercise – Multiple Constraint Pump	276
Inverse Kinematics	278
Animation Exercise – IK Rigging the Chicken	279
Character Skinning	283
Animation Exercise – Skin Binding	283
6.5 Shading – 3D Paint	290
Shading Exercise – 3D Painting	291
6.6 Lighting – Final Gathering in Mental Ray	294
Lighting Exercise – Final Gathering	294
6.7 Rendering – Motion Blur	299

xviii Contents

Rendering Exercise – Motion Blurred Chicken	299
6.8 Layout – Importing Elements	301
Layout Exercise – Importing Elements	301
6.9 Project 6 – Bringing It All Together	305
Index	307

Color Plate I

Maya Image Gallery

The ChubbChubbs and Early Bloomer images in this gallery were created by talented artists at Sony Pictures Imageworks using Maya and other proprietary software. All other images were created by the author, except for On The Ball character modeling and animation and the chicken sketches, which were created by Philip Pignotti.



The ChubbChubbs (c) 2002 Sony Pictures Imageworks Inc. All rights reserved.

Color Plate II



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Color Plate III

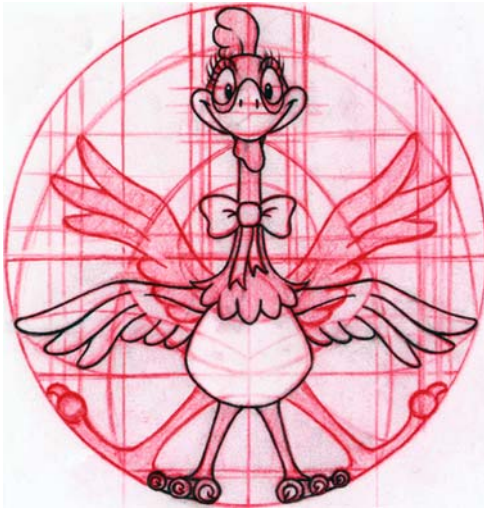


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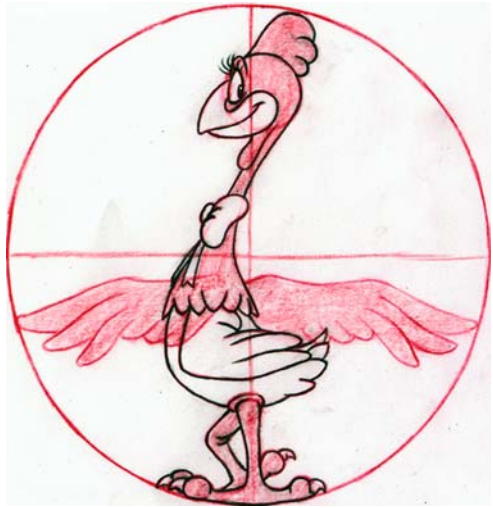


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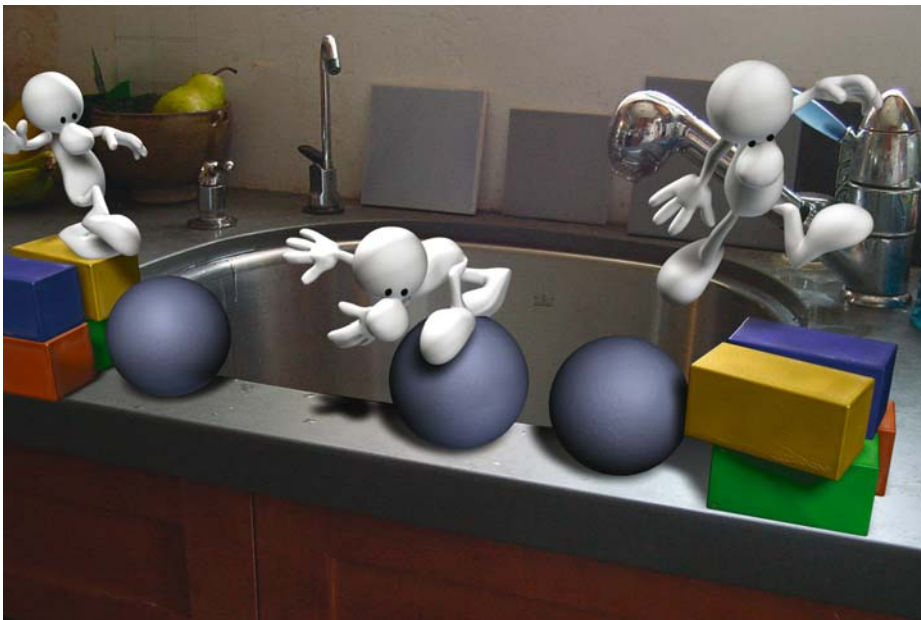
Color Plate IV



Front view of the chicken design

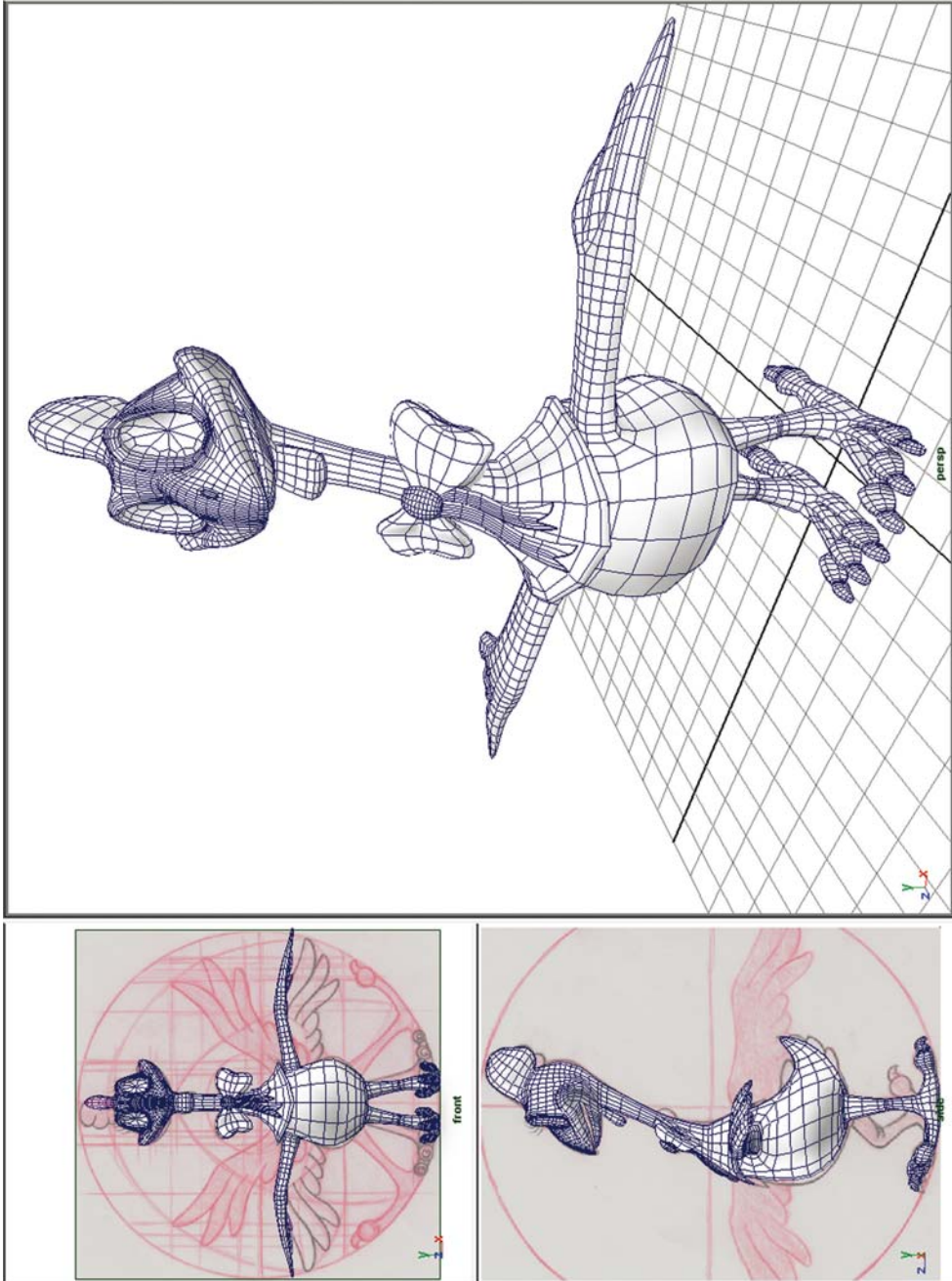


Side view of the chicken design



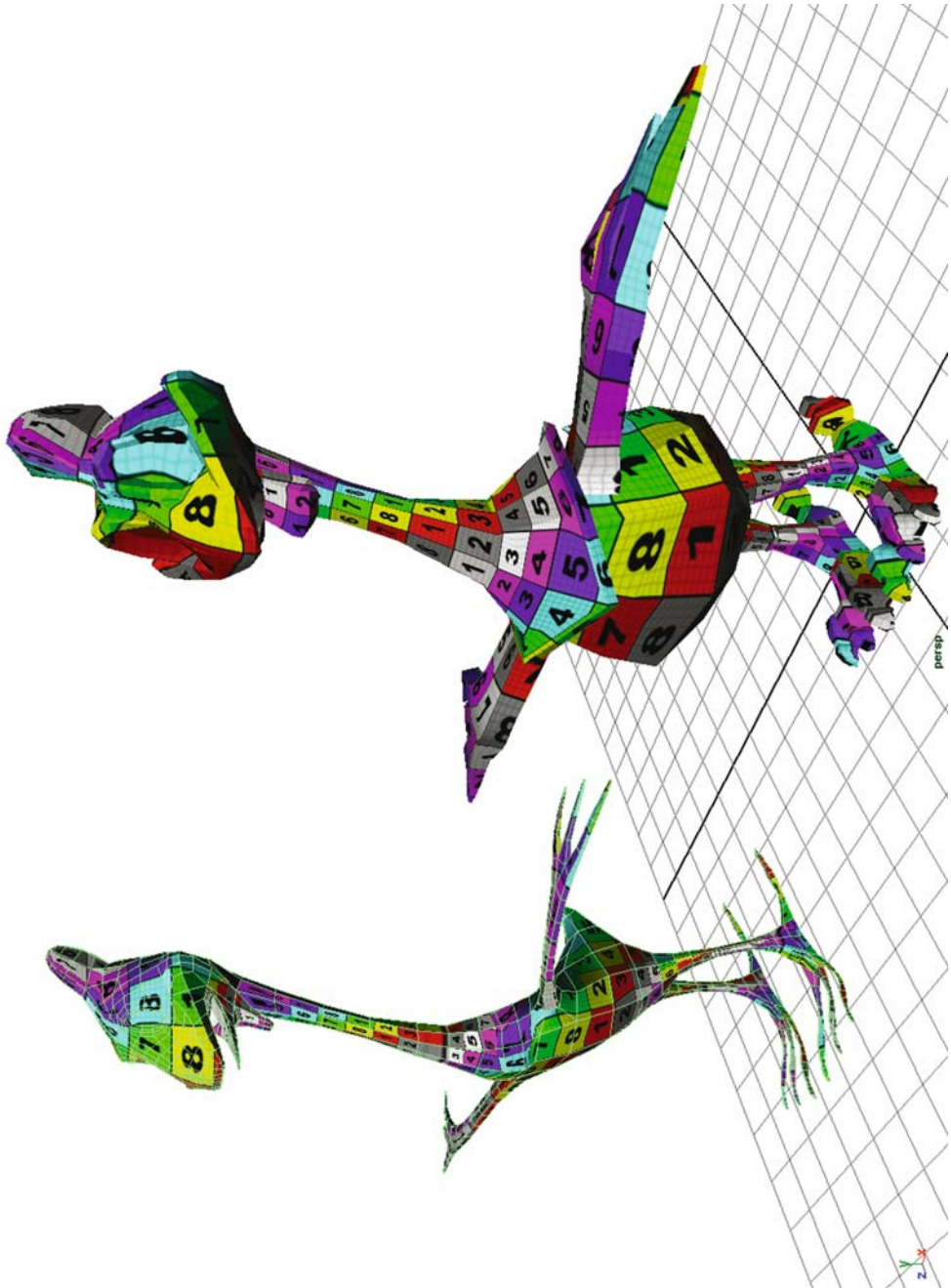
On the Ball by Philip Pignotti

Color Plate V



Polygonal model of the chicken

Color Plate VI



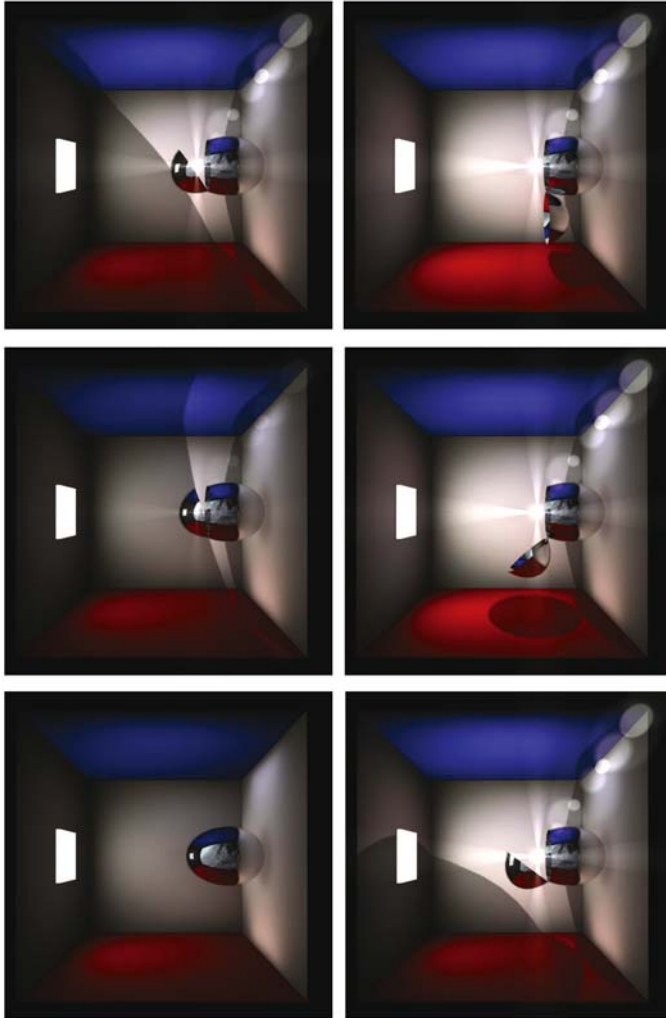
UV texture map transfer on the chicken

Color Plate VII



Final merged scene elements

Color Plate VIII



Optical effects egg from outer space

Color Plate IX



Displaced wing rivets



Plane lit with Final Gather

Color Plate X



Depth of field inside the barn

Color Plate XI



Three point lighting the plane



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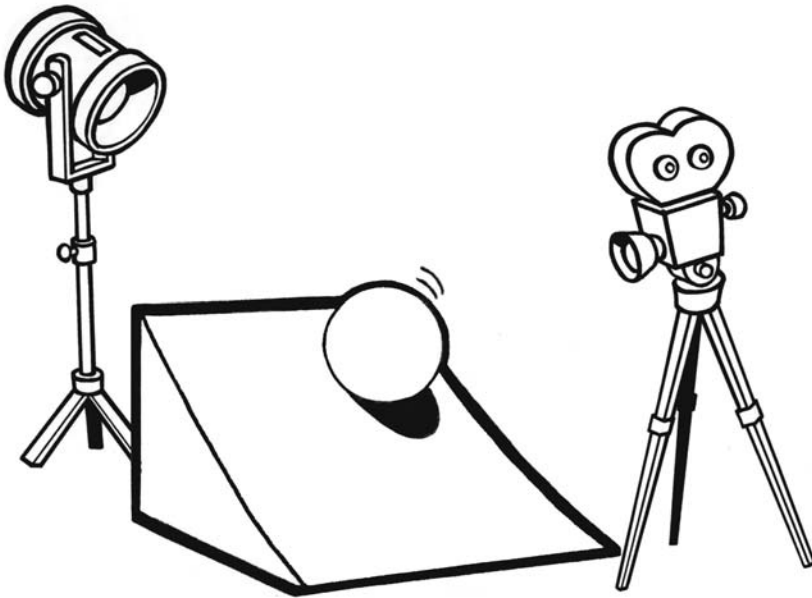
Color Plate XII



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Chapter 1

Essential Skills



2 1. Essential Skills

3D animation in Maya is created by bringing together many parts to form a greater whole. Understanding how these parts relate to each other is one of the keys to learning Maya. Instead of completely focusing on one part at a time, we'll always keep the bigger picture in mind.

So what are these different parts? They are workspace, modeling, animation, shading, lighting, and rendering. This isn't an exhaustive list of Maya's capabilities—I've left out some things such as dynamics, particles, fur, and cloth. The particular areas we'll be focusing on, however, are the fundamentals.

Here is how the basic relationship between these elements works: using the workspace, models are created to represent the form of an object, these models are animated, the look of the model is determined through shading techniques such as materials and textures, lights are placed into the scene, and finally all of these elements are rendered through a camera, to produce the finished frames of your shot.

The skills you learn in these areas (denoted throughout the book by the icons in Fig. 1.1) will enable you to create a short animation of a ball rolling down a ramp. OK, it's probably not going to be the most exciting movie you'll ever create, but it's a good place to start.

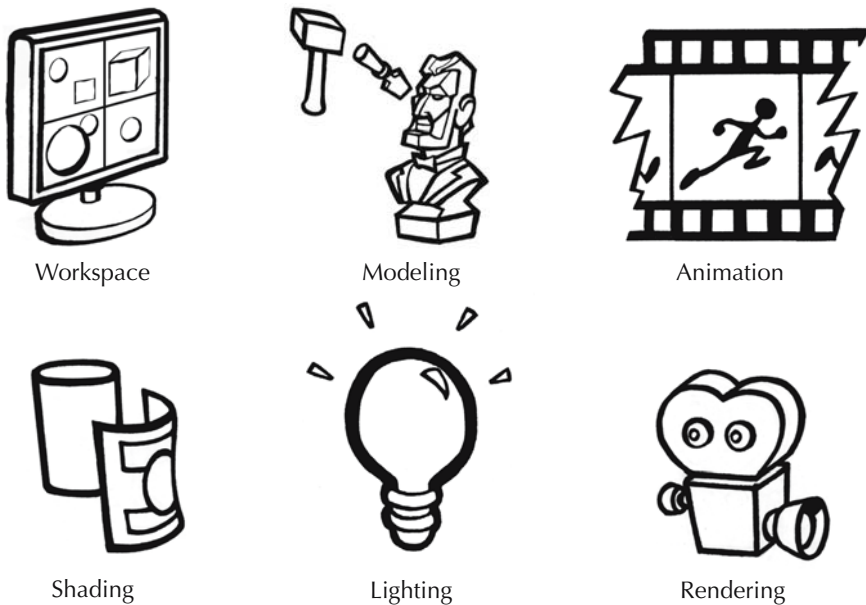


Figure 1.1: Fundamentals of 3D

1.1 Introduction to 3D Space – Cartesian Coordinate System

Two-dimensional space is represented with the X- and Y-axes. 3D animation adds depth, or the Z-axis. This is seen in Figures 1.2 and 1.3 of the plane in perspective.



Figure 1.2: 2D space

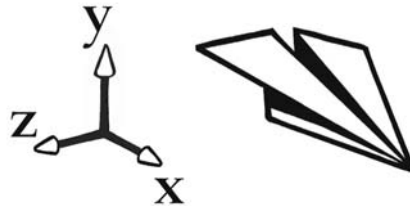


Figure 1.3: 3D space

This three-axis reference system is known as the Cartesian coordinate system. It is used to define many properties of a 3D object, including its position, rotation, and scale. For example, an object's position can be represented as 12, 0, 10 – meaning that it is 12 units to the right of center on the X-axis, 0 units from center along the Y-axis, and 10 units along the Z-axis.

Look at the small view axis locator that appears in the lower left corner of any view panel. It indicates the direction of the X-, Y-, and Z-axes in the world coordinate system. Notice the directions the axes point, as well as their colors. Each axis points in its positive direction; so up = positive Y, down = negative Y, right = positive X, left = negative X, out = positive Z, and in = negative Z. The X-, Y-, and Z-axes are represented by red, green, and blue, respectively. In fact,

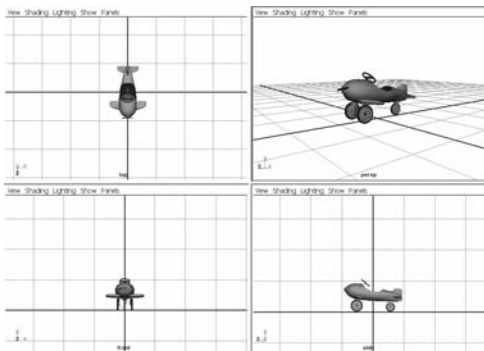


Figure 1.4: Translation: 0,0,0 Rotation: 0,0,0 Scale: 1,1,1

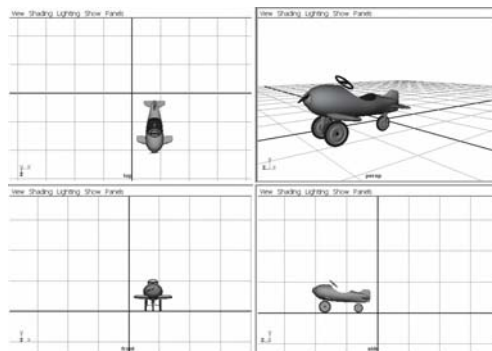


Figure 1.5: Translation: 2,0,3 Rotation: 0,0,0 Scale: 1,1,1